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THE UNIVERSITY OF TEXAS AT DALLAS
PO BOX 830688
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GRANT NAGW-1665
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ENTITLED

"INTERDISCIPLINARY STUDY OF PLANETARY ATMOSPHERES THEORETICAL INVESTIGATIONS"

UNDER THE DIRECTION OF

FRANCIS S. JOHNSON

3RD YEAR FUNDING REQUEST OF $79,325

SEPTEMBER 1994

INTERDISCIPLINARY STUDY OF PLANETARY ATMOSPHERES
THE UNIVERSITY OF TEXAS AT DALLAS

SUMMARY

Continuation efforts are proposed for a one-year period under NASA Grant # NGS-44-044-026. The various areas to be pursued, and on which efforts have been expended during the past year, are described below. Professor William B. Hanson, formerly Director of the Space Sciences Center at the University of Texas at Dallas and an active participant in this research project, was involved in a serious accident on September 8, 1994. On September 11, he died as a result of his injuries: this is a great loss to the planetary atmospheres community. His close associate, Professor Roderick A Heelis, will take over as Director of the Center. Dr. Heelis is also actively involved in the use of retarding potential analyzers and is taking an active interest in the secondary emission part of this research.

PLANETARY ATMOSPHERES

R. R. Hodges

A new version of the Venus model exosphere is in preparation. The code is based on the terrestrial exosphere simulator reported in Hodges [1994]. For Venus as well as Earth, the key factor is the ionosphere model because exospheric velocity distributions tend to be driven by non thermal ion-neutral collisional processes and to a lesser degree, by collisions with fast neutrals that result from dissociative recombination. This work is in collaboration with T. M. Donahue, R.E. Hartle, and J.M. Grebowsky.

COMETARY RESEARCH

R. R. Hodges

Analysis of the data from the neutral mass spectrometer on the Giotto spacecraft continues to be fruitful. Recent publications include evidence for an extended source of formaldehyde in the P/Halley coma (Meier et al., 1993). An important implication of this discovery is that an extended formaldehyde source is incompatible with the production of polyoxymethane (POM) by evaporative processes in the coma. In other research we have shown that the source of ammonia was about 1.5% of that of water, and confined to the nucleus (Meier et al., 1994). We have also shown that the P/Halley production rate of methanol (relative to water) was 1.7%, while the source of hydrogen sulfide was 0.41%

(Eberhardt et al., 1994). Current work centers on a reevaluation of the D/H ratio, which appears to be greater in methanol than in water. Preliminary results of this study will be presented at the DPS meeting.

Extension of the data analysis into the coma beyond the contact surface is heavily dependent on the coma expansion model. The key problem is that model expansion velocities tend to be low. This situation has prompted an effort to make some revisions in the Hodges [1990] coma simulator program that will more accurately account for the distribution of the kinetic energy of photolysis. Improved estimates of rates for photolytic processes will also improve the accuracy of the coma model.

SECONDARY ELECTRON EMISSION IN RETARDING POTENTIAL ANALYZERS

F. S. Johnson, R. A. Heelis, and M. Kirtland

In order to better understand the capabilities of retarding potential analyzers for making electron measurements in planetary environments, we are conducting a series of experiments in which an instrument is bombarded with a low energy electron beam. A range of source energies (up to 80 volts) has been used with various potentials on the grids within the instrument, while the currents collected at each grid and the collector are monitored. The surfaces and grids are cleaned to the standards normally used in spacecraft instrumentation; they are not clean in the sense characteristic of surface physics investigations. Available vacuum equipment, instrument parts, and electronic equipment have been dedicated to this investigation. Observations have identified several phenomena of interest and the data are being used to determine the parameters to be used in future experiments.

Secondary emission on gold surfaces in RPAs due to impacts with energies near 20 eV has been found to have emission coefficients in excess of unity. Beam scattering on passing through grids reduces the incident energy on the collector and widens the energy spread. Upcoming tests will be concerned with quantifying the roles of the incident, reflected, and secondary electrons in the makeup of the measured currents. We will at times use coated grids in an attempt to reduce the importance of secondary emission.

REFERENCES

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